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Lentil Production in Alberta

Introduction and description

Lentils, first grown in southwest Asia, are an annual legume, and one of the oldest cultivated crops known to man. Lentils were first produced in Alberta in the early 1970s, but because of conditions in traditional grain crops at the time, large acreages did not materialize. The area seeded to lentils has fluctuated since then, with the largest, 62,000 ac, occurring in 1987.

Lentils are a high protein crop used primarily for human food, most commonly in soups and stews, in much the same way as dry peas. Widely used in European and South American countries, they are slowly becoming a domestic edible crop in Canada.

Average yields on irrigated land range between 1500 - 1800 lb/ac and long term yields for dryland production would range from 700 - 1200 lb/ac on Brown soils and 1000 - 1500 lb/ac on the Dark Brown and Black soils.

Lentils (*Lens esculenta*) are annual legumes, erect to prostrate in growth. They have slender stems with compound leaves resembling vetch leaves, and their flowers are small and delicate. Lentils are an indeterminate (continuous) flowering plant that will continue to flower until affected by stress or until harvest. Plants average 12 to 18 in. in height depending primarily upon moisture conditions. The pods grow one to two cm in length and contain one or two thin lens-shaped seeds which are commonly green. Two types of lentils are grown in Alberta; a large seeded Chilean type (Laird), and a small seeded Persian type (Eston), with the Chilean type being the most prominent.

Adaptation

Lentils are a cool season crop, with a restrictive root system. They are only moderately resistant to high temperatures and drought. Because of its indeterminate flowering habit, some form of stress is needed in the latter part of the flowering process to encourage maturation of the young pods. Generally, lentils mature in about 90 - 100 days. If planting is delayed until after mid-May, the time to maturity will also be delayed. Young plants can tolerate late spring frosts of minus 5 to minus 7°C, allowing for early spring planting. If the top growth is affected by frost the plant will normally resume growth from one of the secondary buds found below the soil surface. An early fall frost can damage immature seeds within the pods.

Lentils are best adapted to the Dark Brown soil zone of Alberta, but can be grown in most areas of Alberta with a modified management system. High yields are generally obtained if rainfall is 254 - 279 mm (10 - 11 in.). Areas of greater precipitation are not usually suitable for lentil production, as the extra moisture promotes growth and delays crop maturity. Growing lentils under irrigation requires careful management to ensure that the crop is not overwatered and to time water applications properly to allow for early flower initiation, good pod set development, and to mature properly. Adequate but not too much soil moisture is needed for flower initiation and pod and seed development, and a stress later in the season is needed for plants to mature.

Level fields with stone-free soils should be selected. Lentils pod very close to the ground, requiring the swather or combine to cut close to the ground to obtain maximum yields.

Because crops following lentils in the rotation generally yield higher than crops grown after cereals or flax, lentils may be used to extend the rotation in these areas.

Varieties

A summary of varietal characteristics is shown in table 1.

In the early years of lentil production in western Canada, the common Chilean lentil was most widely grown. This lentil is not licensed in Canada, but has been grown under contract.

Laird, a Chilean type yellow cotyledon lentil, was licensed in 1978 by Dr. Al Slinkard at the University of Saskatchewan. It is taller, later maturing and larger seeded than the common Chilean type. Laird has replaced common Chilean as the large seeded variety in Alberta and is the variety of choice for most production areas of Alberta. It yields better and grows taller than other varieties, especially in drier areas. Distribution of pedigreed Laird is controlled by SeCan.

Eston, a Persian type, yellow cotyledon lentil, was licensed in 1980 by Dr. Al Slinkard at the University of Saskatchewan. It is small seeded, shorter in plant

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height, early maturing, and higher in yield than the Chilean types in high moisture areas. Eston is best adapted to the Black soil zone and to irrigated conditions. Distribution of pedigreed Eston is controlled by SeCan.

Table 1: Lentil variety characteristics

Variety	Relative yield (%)	Days to maturity	Seed wt (g/1000)	Seeding rate (lb/ac)	Length of vine or height (in.)
Common Chilean	100	85 - 98	58	49 - 58	19
Eston	124	85 - 97	37	31 - 36	18
Laird	105	90 - 100	79	71 - 76	22

Remarks: Common Chilean is susceptible to ascochyta blight. Adaptability studies indicate that Laird can perform well on Black soils, if proper management is observed, i.e., planted early on wheat stubble. Laird shows some resistance to ascochyta blight.

Seedbed preparation and seeding

The seedbed should be firm, smooth and moist. Stony fields should be avoided or packed or rolled after seeding to bury loose stones that otherwise might be picked up during swathing and harvesting. When seeding into stubble, residues should be sufficiently incorporated to provide a level surface and permit a low cutting height at harvest. Harrowing or packing should be considered a standard practice after seeding. Avoid packing if the ground is wet enough to compact the soil.

Seed lentils 1 to 3 in. deep in rows 6 in. apart as early in the spring as possible, provided the temperature of the surface 1 in. of soil is above 5°C and the soil is not excessively wet. Plan on seeding as early as possible in the spring — preferably the last week of April or the first week of May. Table 2 shows the yield advantage of early seeding. Although seeding can be delayed until mid-May, early seeding increases the height and size of the plant at the time of first blossom. Consequently, the lowermost pods are farther above the ground; the entire plant is taller; the yield is higher, and swathing is facilitated. If a severe frost kills the main shoot, lentils will initiate regrowth from auxiliary buds at one of the nodes below the soil surface. However, maturity will be delayed.

Table 2: Grain yield of three lentil varieties seeded at different dates

Seeding Date	Laird	Eston	Common Chilean
Early May	100	100	100
Mid-May	94	91	114
Late May	39	61	83
Mid-June	9	28	30

Remarks: Mean of three trials conducted under irrigation at Brooks and Bow Island.

Seeding is usually done with a disc or hoe drill, but the disker is perfectly satisfactory. Ensure the soil is well packed after seeding to prevent excessive moisture loss and to obtain good seed-soil contact. However, avoid overpacking, especially when the soil is too wet. Seeding rate depends on seed size. The optimum seeding rate is about 5 seeds per foot of row in rows 6 in. apart or about 1 million seeds/hectare (see table 3). This averages about 34 lb/ac for the Persian (small seeded) lentil, 62 lb/ac for the common Chilean (large seeded) lentil, and 70 lb/ac for the extra-large seeded Laird. Wide row spacing will reduce the yield.

Lentils have the capacity to compensate for lower plant populations, especially the taller, more indeterminate Chilean varieties. The Persian type, Eston, can be seeded a little heavier because it is shorter and does not appear to compensate as much for lower plant population. Seeding rates up to 100 lb/ac of Laird have been used to obtain a thicker stand. The main purpose of heavier seeding is to improve emergence through the soil, to improve the crop's competitive advantage over weeds, and to ensure an adequate stand of tall plants to obtain optimum yields.

Since lentils have an indeterminate growth habit, they continue to grow until restricted by the environment. Highly fertile soils, such as fallow fields high in nitrogen, will result in excess vegetative growth at the expense of seed production, if growth is not restricted by drought or high temperatures. Cereals will respond better than lentils on highly fertile fields. Lentils can be grown successfully on stubble land if weeds are properly controlled. Lentils are a preferred crop for stubble in the Black soil zone and in heavy clay soils. In the Brown and Dark Brown soil zones or soils low in nitrogen, lentils may be grown either on stubble or fallow.

Table 3: Yield (lb/ac) of three lentil varieties grown at different row spacings and plant populations

Plant population	Laird		Eston		Common Chilean	
('000/ac)	9 in.	27 in.	9 in.	27 in.	9 in.	27 in.
250	900	694	—	1068	1113	685
500	952	774	1504	1175	1104	739
750	1024	792	1638	1228	1113	774
1000	1095	720	1753	1264	1113	801
2000	—	—	1870	1032	1121	739

Remarks: Mean of two trials under irrigation at Brooks and Bow Island

Seed treatment and inoculation

Lentil seeds germinate and emerge rapidly; therefore, fungicide seed treatment is not normally recommended.

Lentil seed should be inoculated with the pea, lentil and vetch strain of *Rhizobium leguminosarum*. This will ensure that the lentils fix part of their nitrogen requirement. The rhizobia infect the root hairs of the germinating seed and induce nodule formation. These nodules are the site of nitrogen fixation. Maximum benefit is derived if well nodulated lentils or peas have not been grown previously in the field and the supply of soil nitrogen is low.

The inoculant should be applied with a sticking agent. Inoculant applied as dry powder to the drill box has been proven to be ineffective. The sticking agent ensures good adhesion between the powder and the seed, and provides a food source for the rhizobia until they infect the plant roots. Solutions of powdered milk (one part powder to nine parts water), corn syrup, gum Arabic, sugar or powdered wallpaper glue can be used as a substitute for commercial stickers. Commercial stickers include compounds such as Nitracoat and Nutrigum.

Slurry systems for inoculant application provide the quickest means of sticking the inoculant to the seed coat. The slurry is made by premixing the inoculant, sticker and water and then applying this mixture to a continuous flow of seed being metered through an auger. A garden sprayer or a thoroughly cleaned herbicide tank with a hose and nozzle attached to the outlet may be used to apply the sticker solution to the seed. The inoculum may then be metered into the grain auger, which does a good job of mixing the slurry with the seed. To reduce seed cracking keep the auger flighting full and run the auger at about half speed.

The inoculated seed should be kept out of the sun and seeded within 48 hours of inoculation, since the bacteria will not tolerate sunlight or prolonged drying. Inoculated seed that is not being planted immediately should be kept in a cool, dark location (i.e., under a tarp). Wet seeds may bridge in the drill box so care should be taken to not overwet the seed and to allow one to two hours for drying before being placed in the drill box.

All inoculum is dated to assure freshness so that the bacteria contained on the peat powder are still alive. Because the inoculant has a due date on the package, seed dealers often do not have adequate quantities of inoculant in stock to meet the demand. To alleviate this problem inoculant should be ordered well in advance of seeding. Purchase fresh inoculum specific for lentils, peas and vetches and store it in a cool place until used (a refrigerator is a good place). If the seed has been treated with a fungicide it is advisable to increase the amount of inoculum used.

For more details see the Alberta Agriculture Agri-Fax sheet entitled *Inoculation of Legume Crops*, Agdex 100/23-1.

Fertilizers

Nitrogen is necessary for high yields of lentils, but generally fertilizer nitrogen need not be applied. The nitrogen fixing rhizobium symbiotically fixes between 25 - 40 per cent of the nitrogen required by the lentil plant and the rest is obtained from the soil. Stubble fields testing less than 22 lb N per acre will benefit from the application of 18 - 27 lb N per acre. Avoid, if possible, applying fertilizer nitrogen with the seed. A soil test is needed to obtain the most accurate recommendation for a particular field.

Levels of nitrate nitrogen above 44.5 lb/ac in the soil have been observed to inhibit nitrogen fixation.

Phosphorus is required in relatively large amounts by lentils. Side-banded phosphate fertilizer generally gives a better response than seed-placed fertilizer. If side-banding equipment is not available, then rates of phosphate (P_2O_5) should not exceed 62 lb/ac of 11-48-0 applied with the seed. Rates should be based on a soil test.

Sulfur is required for high yields. Some common fertilizers contain sulfur. If a soil test indicates a need for sulfur, a product such as 16-20-0 which contains 14 per cent sulfur may be applied with the seed at low rates. Sulfur is already present in sufficient quantities in the irrigation water of southern Alberta; most probably more is not needed on crops grown under irrigation.

Weed control

Successfully eliminating weed competition represents one of the most important steps in profitable lentil

production. Lentils are short and do not form a dense canopy even under the best of growing conditions. This results in most of the common annual grass and broadleaved weed species competing effectively with lentils throughout the growing season. However, weed competition is particularly severe during establishment of the lentils and during periods when low soil moisture limits growth. Lentils should NOT be grown on land where perennial weeds are known to be a problem, as chemical control is not possible. Volunteer grains can become a serious weed problem when stubble cropping, particularly following a dry autumn. Studies conducted by the Crop Development Center indicate that seed yield losses caused by infestations of both grass (table 4) and broadleaved weeds generally range from 25 per cent to 75 per cent of potential lentil yield. These losses are generally greater than for other field crops, particularly under low weed densities.

Table 4: The effect of several wild oat densities on lentil yield (Crop Development Centre, Saskatoon).

Wild Oat Density		Lentil Yield	
number per square foot	number per square metre	lb/ac	(kg/ha)
0	0	2000	2240
3	32	1145	1285
7	75	965	1080
11	118	785	880
14	151	520	585

Currently, the number of herbicides registered for use on lentils is very limited. For an up-to-date listing refer to *The Guide to Crop Protection in Alberta Part 1*, Agdex 606-1. Commonly used herbicides include Treflan, Edge, Sencor, Hoe Grass and Poast.

Sencor provided the only postemergent control of crucifers (mustards, volunteer rapeseed and stinkweed), lamb's-quarters, tartary buckwheat smartweed, corn spurry, chickweed and hemp nettle in lentils. Lentils must be planted at least 2 in. below the soil surface to prevent a phytotoxic effect if Sencor is used. Sencor is leached after a heavy rainfall. Do not apply for five days after frost or if rainfall is expected within 6 hours, and allow a five-day interval between application of Sencor and other pesticides. Sencor is not registered for use on soils with less than 4 per cent organic matter. This would include most Brown and Dark Brown soils. If Sencor is used on irrigated lentils a waiting period of 7 -10 days should be followed before any further irrigation is done. Do not apply Sencor more than once per crop season. High temperatures or frost after application may cause temporary yellowing and delayed growth.

Herbicides are not available to provide adequate control of perennial grasses, thistles and volunteer cereals. A grower must develop a long-term approach to weed control by effectively manipulating rotations and herbicides, (particularly in spring cereals where a wide range of chemicals is available), in order to reduce weed populations during other parts of the cropping sequence.

Lentils do not compete with perennial weeds. When stubble cropping it may be necessary to sacrifice small areas of the crop to permit spot treatment using glyphosate (Round Up) in areas of dense thistle stands. An application of glyphosate using a rope wick has provided promising results for controlling thistles by wiping the chemical on the thistle canopy above the lentil crop. Avoid drift from phenoxies such as MCPA and 2,4-D, since lentils are very sensitive to these products. Do not plant lentils on ground which has been treated with a soil-residual herbicide the previous year. Residual herbicides of concern include Glean, Tordon 202C and Lontrel. The number of years required to wait after application of one of these products depends on the product used and on the soil type. Glean remains very active in the soil for up to five years in soils with a pH exceeding 7.5. Tordon 202C normally requires a waiting period of four years. Lontrel is normally inactivated within two years. When seeding lentils on newly rented land it is particularly important to know the herbicide history of the field for the previous five years.

CAUTION - ALWAYS READ AND FOLLOW LABEL INSTRUCTIONS WHEN USING HERBICIDES

Insect pests

Insect damage to lentils is seldom noted, but cutworms can damage the crop. Wireworms can also damage emerging seedlings. Occasionally blister beetles are noted, but damage has not been apparent.

Cutworm larvae can destroy seedlings at the surface or just below the surface of the soil by cutting off the seedling. They feed during the night. Generally, cutworm damage occurs in late May or the first three weeks of June. If spraying is necessary it should be done at dawn or dusk to reach the larvae during an active period.

Wireworm larvae can bore into lentil seeds or destroy young seedlings by damaging the plants just below the soil surface. They are most frequently found in crops grown on grass breaking.

If serious insect damage is found, the grower should consult the nearest district agriculturist for recommended insecticides.

Diseases

Sclerotinia wilt, botrytis grey mold, Fusarium root rot, rhizoctonia root rot and ascochyta blight are the five major diseases affecting lentils. Currently the main control for sclerotinia wilt and the root rots is to maintain a four year crop rotation between susceptible crops. Over 200 broadleaf crops are susceptible to sclerotinia, including all the pulse crops, canola, sunflowers and carrots.

Soil-borne root rots may become serious in individual fields. Normally, isolated plants become infected and die at various stages during the growing season, but this presents no problem. More serious situations occur where small areas scattered throughout the field ripen prematurely, owing to death of the roots from root rot infection. A four to five year rotation with cereal crops will delay buildup of root rot in the lentil crop.

Sclerotinia, or white mold may occur under high fertility conditions following a prolonged rainy period in July or following the application of excessive amounts of irrigation water. The high fertility conditions, in the absence of heat or drought stress, promote excess vegetative growth which lodges to form a dense vegetative mat. Prolonged rainy weather promotes rapid growth and the spread of white mold on the vines lying on the moist soil under this vegetative mat.

Botrytis, or grey mold may occur under the same conditions that will induce sclerotinia. A dense canopy with dying tissue and pods touching the ground combined with cool, humid weather are conditions conducive to the development of grey mold.

Botrytis reproduces more easily than sclerotinia and thus can be a more explosive disease under the right conditions.

Control of sclerotinia and botrytis is similar in that a four year crop rotation between susceptible broadleaf crops is required. Fungicides are effective in control but research is required on timing and cost effectiveness for lentils.

Ascochyta blight occurs on leaves, stems, pods and seeds and may become serious if the immature pods and seeds are subjected to prolonged wet weather in the swath. Severely infected seed lots may not be saleable or may be docked severely. Do not seed lentils on lentil stubble. When using your own seed have an ascochyta test done before planting to ensure less than one per cent of the seeds are carrying the ascochyta organism.

Flooding of a portion of the field during the growing season will result in death of the plant since lentils cannot tolerate much flooding. However, this is not caused by a disease organism.

Irrigation

While further research work on proper irrigation scheduling for lentils is required to obtain maximum economic yields, a number of suggestions can be made.

Lentils are, mainly, a dryland crop which does not have a high requirement for water. Like most legume crops produced for seed, soil moisture is not considered critical until flower buds begin to form. Before this, soil moisture should be maintained at a reasonable level and irrigation should be considered when the soil is at 40 -50 per cent of field capacity.

Moisture is critical to lentils from the time that buds begin to develop until seed formation is completed. During this period drought stress will greatly reduce yields.

Lentils can easily be overirrigated and care should be taken to supply as little water as possible and still achieve the yield desired. Overirrigated lentils will not experience a drought stress period and will remain vegetative or produce few pods, will produce a rank growth that is more sensitive to diseases, will be delayed in maturity and will often yield very poorly. Highly fertile irrigated soils should be avoided as this will compound the problem of vegetative growth.

Lentils cannot stand flooding or wet feet, so gravity systems or rolling fields that pond and which do not drain easily should not be used.

As a general rule, when lentils are grown under wheelmove systems only two water applications are required. These applications would normally be a four hour and an eight hour set. Timing the sets any longer will normally result in crop yellowing and thinning caused by watering-logging.

With a pivot irrigation system no more than 254 mm (10 inches) of water should be applied during the growing season.

A certain amount of risk is present when attempting to grow lentils under irrigation. Lentils are very sensitive to overwatering, especially if rainfall occurs after irrigating. This can cause flooding injury which sets back and weakens the plants and makes them more susceptible to root rot diseases. If plants do not die from flooding, overwatering will encourage an excessive amount of vegetative growth that can reduce pod set and delay maturity.

Harvesting

Extreme care must be taken in harvesting lentils! Often the harvesting procedure will turn growers off growing lentils ever again. It is important that growers be aware of what is in store for them at harvest so that their equipment is ready and they are mentally ready.

The vines are often only 8 to 16 in. tall, so the swather must be operated as low to the ground as possible. Swathers with a relatively short table are pre-

ferred, as they cut closer to the ground on uneven land. A swather equipped with a floating cutter bar, a pickup reel and half moon lifters (only in a heavy, lodged crop) will do the best job. However, many farmers have done a satisfactory job of swathing with forage swathers or grain swathers equipped with a pickup reel and operated slowly or only in one direction. Swather speed will commonly be 1.5 - 2 mph. Adjustable -height wheels at the sides of the cutter bar will aid in maintaining a more even cutting height and will speed up swathing. Modified swathers with a widened throat may facilitate the handling of heavy crops. Refer to Alberta Agriculture's Agdex 745-1 *Bulky Swaths Improved With a Modified Swather* and Pami report No. R0280 *Windrowing With a Floating Cutterbar*, for further information.

When to swath?

Lentils have an indeterminate growth habit and continue producing new flowers and immature pods until stopped by heat, drought or low nitrogen. Lentil pods shatter readily and must be swathed when the EARLIEST PODS TURN LIGHT BROWN AND RATTLE. Shattering may be reduced by swathing at night when the higher humidity helps toughen the pods. The light fluffy lentil swaths are easily blown by wind the first day or so after swathing, but quickly settle; therefore, rolling is advised in areas of high wind and in tall stands. Care should be taken when using a swath roller to ensure it is only sealing the swath and not causing a large amount of shattering. A V-shaped roller is recommended to seal the edges of the swath.

The cutter bar on the swather will occasionally gum up from the sap in the lentil stems. A light rinse in soapy water will reduce this gum temporarily.

When to thresh?

Lentils normally are ready to thresh about one week after swathing. However, if the swath becomes too dry the stems will break into small pieces, and remain with the seed. Excessively dry seed will chip and split badly during threshing. It may be preferable to thresh them at about 20 per cent moisture and dry them down to 16 per cent or less for safe storage.

Low cylinder speeds are required to reduce seed chipping and splitting during combining. Cylinder speeds of around 350 rpm are normally used, depending on machine type and the moisture content of the lentils. Special care must be taken to avoid chipping and nicking the edge of the flat seeds since this greatly reduces seed quality. Combine augers and grain loaders should be operated at low speeds to prevent chipping, cracking, and to reduce split and broken seeds.

Lentils containing green weed seeds or other high moisture materials should be cleaned as soon as possible to prevent heating. Moisture levels up to about 16 per cent are considered safe for lentils. Lentils with a moisture content of 14.1 to 16.0 per cent are graded 'Tough' and those over 16.0 per cent are graded 'Damp'. If drying is necessary, do not exceed a maximum air temperature of 43°C.

Natural air drying of lentils has several advantages over heated air drying. Advantages include the elimination of stress cracks, and a reduction in augering, in energy costs and the amount of supervision required.

Marketing

Contracts are available for lentils and most producers take advantage of the price and delivery security which they offer. The contract which best suits a particular producer's marketing strategy should be carefully assessed. Fixed price, open pricing and pooling type contracts are generally available for lentils from a large number of companies.

Producers should be aware that growing lentils without forward pricing at least part of the production is risky. It is therefore advisable to become fully aware of the implications of growing lentils with or without a contract before making a decision. Many producers consider the following strategy a sound one: forward sell part of the expected production at a fixed price, then sell the balance of the production in the fall. Such a policy provides some price protection (against a falling market), plus the opportunity to benefit from market strength on part of the crop. Alternatively, many producers like to be part of a pool, and pooled contracts are usually available from a number of companies.

A market synopsis outlining companies currently active in Alberta is distributed by Alberta Agriculture each spring. The synopsis also outlines the types of contracts available from each company.

References

1. *Lentil Production in Western Canada*
   University of Saskatoon,
   Saskatchewan Public #413, Agdex No. 149/10
2. *Lentil Production in Manitoba*
   Manitoba Agriculture, Agdex No. 147

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